Bell Laboratories Record

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A Statement of Policy

By WALTER S. GIFFORD

President, American Telephone and Telegraph Company

Before the National Association of Railroad and Utilities Commissioners

BROADLY considered, you as Public Utility Commissioners and we in the telephone business, are engaged in a common enterprise; our success must depend upon mutual confidence and understanding. In the current performance of our daily tasks it is possible to lose sight of the ultimate aim and goal of our endeavors. With the thought in mind that it may prove helpful, I wish to state very briefly the principles that guide the management of the Bell System.

There are today over 420,000 stockholders of the American Telephone and Telegraph Company and no one of them owns as much as one per cent of the capital stock. The business of this Company and its Associated Bell Telephone Companies, whose common stock is largely owned by this Company, is to furnish telephone service to the nation. This business from its very nature is carried on without competition in the usual sense.

These facts have a most important bearing on the policy that must be followed by the management if it lives up to its responsibilities. The fact that the ownership is so widespread and diffused imposes an unusual obligation on the management to see to it that the savings of these hundreds of thousands of people are secure and remain so. The fact that the responsibility for such a large part of the entire telephone service of the country rests solely upon this Company and its Associated Companies also imposes on the management an unusual obligation to the public to see to it that the service shall at all times be adequate, dependable and satisfactory to the user. Obviously, the only sound policy that will meet these obligations is to continue to furnish the best possible telephone service at the lowest cost consistent with financial safety. This policy is bound to succeed in the long run and there is no justification for acting otherwise than for the long run.

It follows that there is not only no incentive but it would be contrary to sound policy for the management to earn speculative or large profits

for distribution as "melons" or extra dividends. On the other hand, payments to stockholders limited to reasonable regular dividends with their right, as the business requires new money from time to time, to make further investments on favorable terms, are to the interest both of the telephone users and of the stockholders.

Earnings must be sufficient to assure the best possible telephone service at all times and to assure the continued financial integrity of the business. Earnings that are less than adequate must result in telephone service that is something less than the best possible. Earnings in excess of these requirements must either be spent for the enlargement and improvement of the service furnished or the rates charged for the service must be reduced. This is fundamental in the policy of the management.

The margin of safety in earnings is only a small percentage of the rate charged for service, but that we may carry out our ideals and aims it is essential that this margin be kept adequate. Cutting it too close can only result in the long run in deterioration of service while the temporary financial benefit to the telephone user would be practically negligible.

Our policy and purpose are the same as yours—the most telephone service and the best, at the least cost to the public. Without overlooking the fact that we lack the big money incentive for maximum profits and the drive for improvement that results from active and strong competition, we believe the telephone company is organized to make continuous and effective progress.

Professor Cabot of the Harvard Business School made the following comment on the Bell System: *"The thing is a modern miracle which I can only explain to myself by assuming that the men who conceived, created and have developed the telephone were men of the rare automotive type whose driving power came from within, and who, therefore, did not need the external stimulation which competition alone can give."*

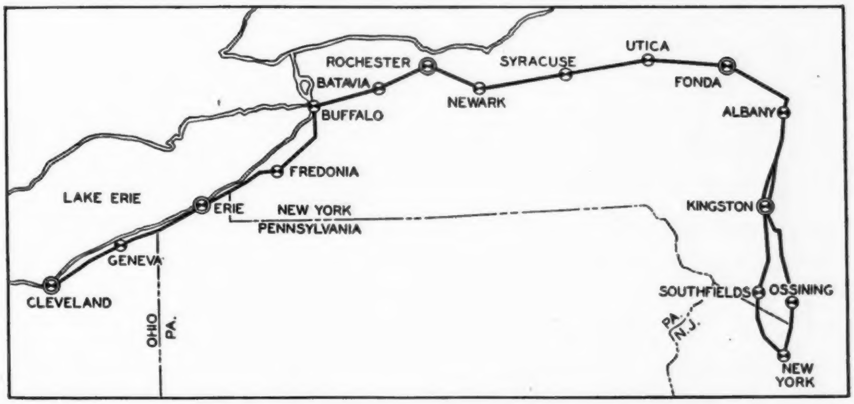
Undoubtedly a very great factor in the continued progress and improvement of telephone service is the intangible but quite real spirit of service that has become a tradition in the telephone business, but the results of the Bell telephone business have a broader foundation than the one Professor Cabot has recognized. It is fundamental in our plan of organization to have at headquarters and in our laboratories several thousand people whose sole job it is to work for improvement. They are engaged in studying what is used in the telephone business and how it is used and endeavor to find a better thing or a better way. Of course, the people who are engaged day by day in trying to maintain a high standard of telephone service are doing their part, and a most important part, in increasing the quality and keeping down the cost of service, but progress is assured by having a large group of scientists and experts devoted exclusively to seeking ways and means of making the service better and cheaper.

It is now nearly 20 years since the State Commissions generally took over the duties of regulating the telephone companies. During those 20 years the physical results of your regulation and our operation are impressive. In 1907 there were about 6,000,000 telephones in the United

States but they were only partially interconnected, while today there are over 18,000,000 telephones in the United States so interconnected that it is possible for practically any one of the 18,000,000 to be connected with reasonable promptness with any other one of the 18,000,000. Thus today, practically any one anywhere can talk by telephone with any one else, anywhere else in the country. Moreover, any one in the United States can now converse by telephone with any one in Great Britain, Canada, Cuba and the principal cities of Mexico. This is real progress in extent and facility of communication, but we realize we are still far from our ultimate goal.

With your sympathetic understanding we shall continue to go forward, providing a telephone service for the nation more and more free from imperfections, errors or delays, and always at a cost as low as is consistent with financial safety.

New York-Cleveland Cable Completed



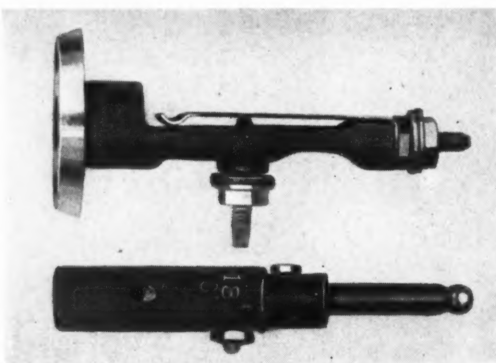
The first billion-dollar mark in Bell System plant investment took forty-one years to reach. Another billion was added in six years, while the third billion-mark was passed some time last August, less than four years later. Of these huge sums and of the $270,000,000 which will have been expended for net additions to plant during 1927, a large part has been invested in equipment developed in Bell Telephone Laboratories.

For example, lead-antimony cable sheath, permalloy - and iron-dust cores for loading coils, vacuum tubes and their associated circuits, and the metallic morse system are outstanding elements of the recently completed New York-Cleveland toll cable project. This cable will provide facilities for more than 250 telephone conversations and 500 telegraph messages.

Fifty Years of Telephone Plugs

By PAUL NEILL
Apparatus Development Department

ON the first commercial telephone switchboard, installed in New Haven in January, 1878, the connections between subscribers were made by means of crude switches consisting of pivoted metal strips fitted with hard rubber handles. These made contact with metal buttons screwed into the wood from which the switchboard was made. In certain other switchboards built about the same time, each line, which used only a single wire with ground return, was terminated on a metal bar. Between these, contact was made by insertion of brass pegs such as are used extensively in railroad telegraphy and in some forms of Wheatstone bridge.



Warner jack and plug, brought out in 1882

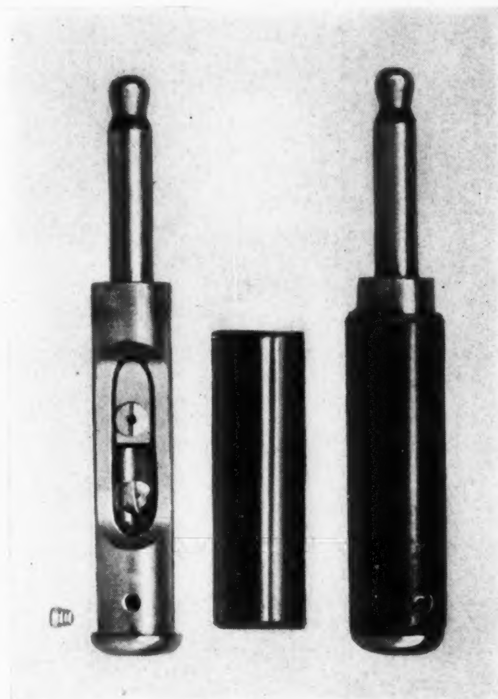
Though switchboards were made less bulky by use of peg-type plugs, the growing demand for telephone service showed that other lines of development must be followed to attain greater flexibility and compactness. Consequently in the fall of that same year Charles Williams of Boston built a switchboard employing pairs of plugs connected by cords. In these, the first telephone plugs with attached cords used commercially, there was a single conductor, adequate for the simple circuits of that time.

In 1882 came an approach to present apparatus, the plug and jack developed by J. C. Warner in Chicago, and used in the "Standard" Western Electric switchboard which was produced that year. The plug was made with rounded tip contact and cylindrical sleeve, separated by a tube of insulation; connections to the cord were made externally, on opposite sides. Though crude when judged by today's standard, this plug marked a direct and most prominent step toward those now in use.

Changes in switchboard design followed each other in close succession to take care of the rapidly growing list of subscribers and the steadily increasing traffic. With the changes came need for improvement in plugs and jacks, and reduction in size so that they could be placed closer together. The individually-mounted jacks were decreased in size, and then were supplanted to a large extent by jacks mounted in strips; by this means the space needed for the mounting was greatly reduced. At the same time the plugs were made smaller, and the connections were made inside the shells. Thus the ends of the

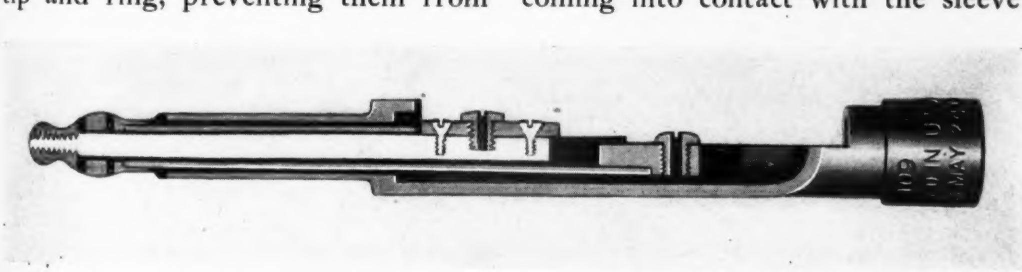
conductors were protected, making it possible to place the jacks much closer together.

With the development of metallic circuits, a third contact member in the plug became necessary to take care of the three conductor multiple. Accordingly a three-contact plug—No. 37—was brought out about 1891. The contact members were tip, ring, and sleeve as at present, but the profile was considerably different from that of today, since ring and sleeve were of the same diameter. The ring contact surface was separated from tip and sleeve only by narrow collars of hard rubber. This plug was followed by several others of approximately the same shape and general design. About 1897 came the No. 49 jack, and with it a new plug, No. 64. Between tip and ring was a wide insulator of hard rubber, having the same diameter as the sleeve; the diameter of the ring was less, about the same as that of the tip. This plug, whose profile showed the direction which development would take, gave good results electrically, but wear on the insulating collar was excessive, and there were other mechanical difficulties. This plug was very shortly superseded by the No. 104, in which the broad rubber collar was replaced by a band of brass insulated from other parts of the plug, termed the "dead collar". This band acts as a spacer between tip and ring, preventing them from touching simultaneously the ring contact spring or the sleeve of the jack during insertion or withdrawal. About 1905 the No. 104 plug was



The No. 47 plug, used for test boards, magneto switchboards and private branch exchanges

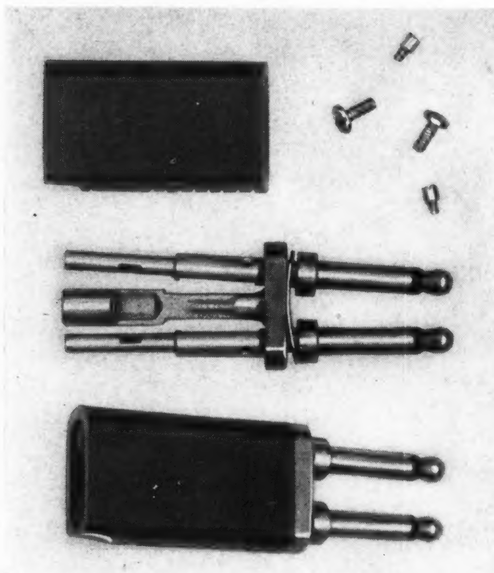
replaced by the present No. 110, which is similar in general design but is marked by several changes in profile. One point of improvement, whereby the tip and ring of the plug were more effectively prevented from coming into contact with the sleeve



Sectional view of the No. 109 plug, enlarged by two thirds

of the jack, was use of a dead collar with flat top in place of the collar with rounded outer surface which had been used on No. 104 plug.

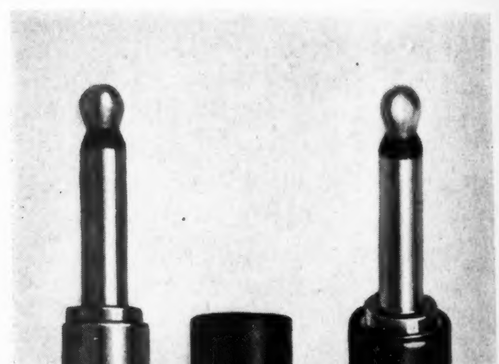
During these developments, in-



Twin plug used at toll test boards

crease in the number of telephone subscribers and growth of telephone traffic had continued rapidly, necessitating further compactness of telephone facilities. The size of jacks and plugs was an important factor in limiting the number of lines which could be terminated within reach of an operator. The minimum spacing for No. 49 jacks, both vertical and horizontal, is 7/16 inch, and so to meet the demand for economy of space, No. 92 jacks, which are spaced 3/8 inch apart, were brought out in 1901. By their use in the multiple of B-switchboards as many as ten thousand five hundred lines are terminated within reach of a single operator. With this jack came a corresponding plug, the No. 101, similar to the larger No. 104 design; it was replaced about 1904 by the No. 109, which remains the smallest standard Western Electric plug made with three conductors. Approximately four hundred thousand of these plugs are made each year, and almost as many of the No. 110; there are probably a million of each of these models in service throughout the country.

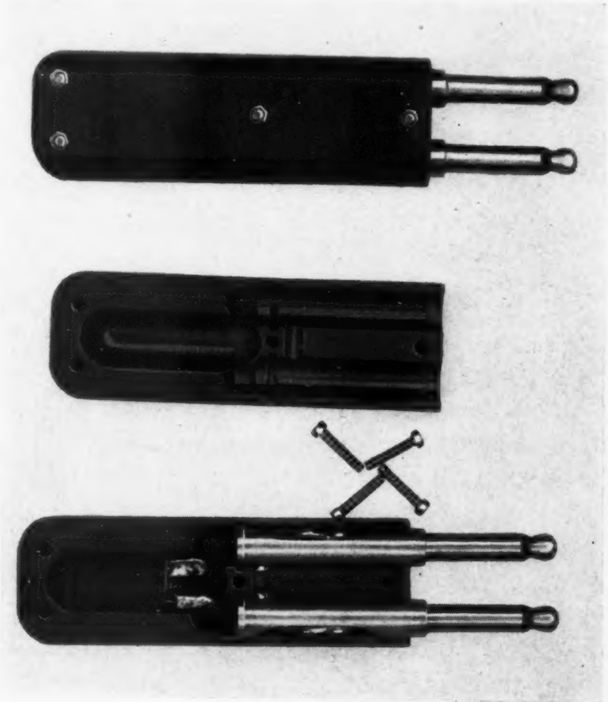
The construction of these two currently-used plugs is almost the same except for size. On each, connection of the cord tip and ring is made with small button-head binding screws inside the shell. Connection to the sleeve is made by folding the bare



Plug with resistance unit for use in telegraph circuits

end of the sleeve conductor back over the cord insulation. Then when the cord is screwed into the open threaded end of the sleeve, the exposed conductor is wedged against the inner threads, and makes contact with them. In addition the outer braid of the cord is held by these threads, so that the strain is borne by the outer braid rather than by the conductors. Essentially these plugs are made up of concentric tubes, alternately of metal and of insulation. The principal member, outermost, is of brass; at one end it forms the sleeve contact, and at the other the body, around which the shell is placed. Directly inside is a tubular insulator, with a flange at the end to form a spacer between sleeve and ring. Inside this insulator is a thin brass tube, bearing at one end a flange which forms the ring contact and at the other end a short brass rod, semicircular in cross-section, to which the ring conductor of the cord is fastened by a binding screw. Enclosed in the ring tube is another insulating tube, and inside that is a steel rod which forms the center and backbone of the plug. To the outer end of the rod the tip contact is screwed, and at the other end is fastened a connection plate to which the tip conductor of the cord is fastened. The dead collar, made of an alloy chosen for its wearing qualities, is placed between tip and ring; it is separated from them by insulating washers, and from the plug center by the inner insulating tube. The tubular shell by which an operator grasps the plug is of fibre, fastened to the main body by a small screw. Handling of these shell screws, and the binding screws as well, is facilitated by a small hole at the center of each, which fits the tapered prong of a special screwdriver.

Although by far the greater part of the plugs made each year are No. 109 or No. 110, there are many others used for various purposes. Most common of these is the No. 47,



Twin plug with resistance unit, for balancing toll circuits during testing

of which about 60,000 are made annually. It is used principally for private branch exchanges, magneto switchboards and test boards. The sleeve is a quarter inch in diameter, and the tip, pear-shaped, is slightly smaller.

In addition there are a number of "twin" plugs, essentially two plugs

mounted in a single shell or handle. Twin plugs now in general use have their "fingers" mounted flexibly to permit them to align themselves readily with jacks whose spacing varies somewhat. In most of the twin plugs the individual fingers are two-conductor units, of which the part entering the jacks is practically the same as the corresponding part of the No. 47 plug. Examples are plugs used for connecting operators' headsets, and those used for toll test boards. Other twin plugs have three conductors in each finger, and consist of two No. 110 plugs mounted with a single shell. They are used principally for connecting the balancing network of cord circuit repeaters.

In addition to such plugs as have been described, there are in the telephone plant many contact-devices of unique design for special purposes. Some, in the form of plugs, contain a resistance unit in series with their contacts. Others, of entirely different construction, are used in dial systems for emergency transfer of traffic from one circuit to another, and many have as many as sixty-six contacts. But although classed as plugs, these are very different from the simple, compact little members through which billions of calls are completed yearly.

Humidity Test Equipment

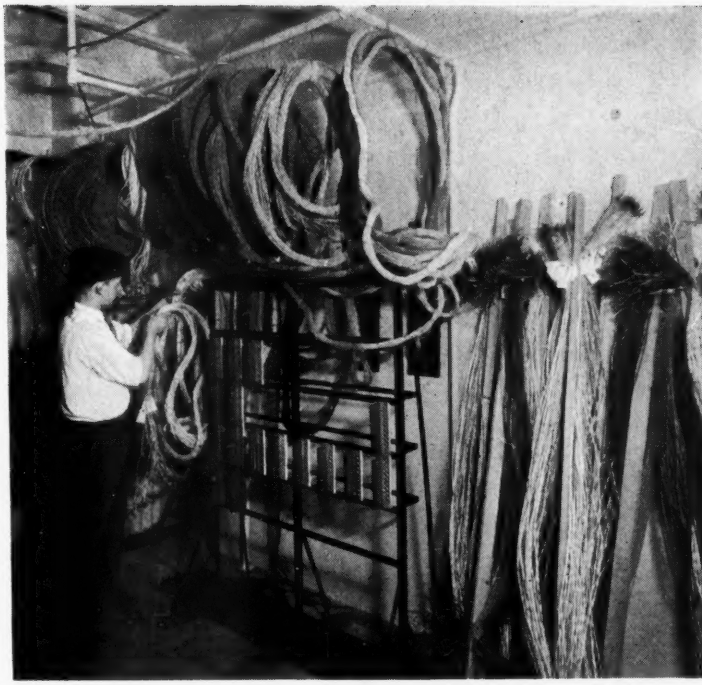
By E. B. WOOD
Apparatus Development Department

MILDEWED garments and swelling or sticking bureau drawers are commonplace phenomena in the summer time. They are particularly so in rainy weather. In winter, on the other hand, in heated homes, a shrinkage or warping of furniture and doors is equally common. If we seek the causes of these changes in materials between summer and winter we find it due to the amount of moisture or water vapor which is in the air and therefore available for absorption by wood or other fibrous or absorbing substances. In a room having a volume of one thousand cubic feet the air in winter contains normally less than one-fifth of a pint of water in the form of vapor while in summer the amount may be one and a half pints, or more than seven times the winter quantity.

The amount of water vapor in the air is generally measured in per cent of the maximum amount the air can hold at that temperature and pressure. This percentage is usually spoken of as the relative humidity. The summer condition mentioned above corresponding to approximately ninety per cent relative humidity at 85 degrees Fahrenheit is so near to the saturation point that the addition of one-fifth of a pint of vaporized water or a drop of three degrees in temperature would result in the formation of fog.

It is not surprising in view of these data and experiences that telephone apparatus with its complex electrical circuits and closely adjusted moving parts should be especially susceptible to the effects of moisture. The importance of such effects has been recognized in the design of telephone

apparatus for many years. However, as the extension of machine-switching and long distance communication systems has demanded closer operating limits and more rigid requirements for apparatus, the importance of atmospheric conditions has greatly increased and a more precise knowledge of their effects has been required.



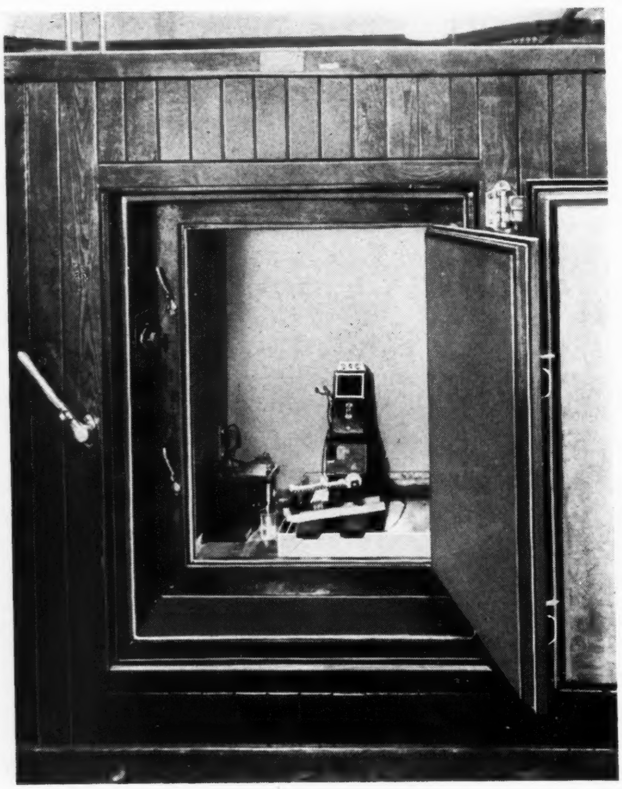
Interior of large cork-insulated room, showing cable wires and terminal blocks undergoing test

In response to the demand for improved facilities for the study of the effects of humidity, laboratory testing methods and equipment have been completely revised within recent years and additional testing facilities are constantly being provided as the volume of humidity testing increases. The equipment in present use in the General Development Laboratory may be divided into three groups comprising large cork insulated rooms, air-tight stationary chambers and small portable units.

In the first group we have three rooms, each of approximately 1500 cubic feet capacity. The temperature and humidity of each are controlled by a system of sprays and water-cooled radiators or electric heaters, through which the air from the room is circulated by a centrifugal blower and so is conditioned as desired. This apparatus is capable of reproducing atmospheric conditions ranging from 30% to 95% in humidity and from 70 degrees to 110 degrees F. in temperature, thus covering practically the entire range of conditions normally existing in telephone buildings. The operation of the equipment is automatic and the accuracy normally obtained is plus or minus one per cent in humidity and plus or minus one-half degree F. in temperature. These rooms are large enough to permit the testing under actual operating conditions of large pieces of assembled apparatus as well as small parts and raw materials. An important feature of this equipment is its flexibility, permitting sudden changes in humidity and temperature to be made and thereby allowing apparatus to be studied under the fluctuating conditions which have been found to exist in nature.

In the second group we have two chambers, one of fifty and the other of four cubic feet capacity. These consist of an inner air-tight chamber within a surrounding compartment

which is thoroughly heat-insulated from the outside air. The humidity in the inner chamber is controlled by the use of a solution of sulphuric acid contained in a large shallow lead tray over which the air is circulated by a fan. The manner in which the sulphuric acid and water control the humidity will be discussed later. The temperature is controlled by thermostatically regulated electric heaters located in the eight-inch surrounding compartment. For temperatures below room temperature an ice-box is provided through which the air in the outer enclosure is circulated by a blower. The walls of the inner chamber are composed of layers of wood, paper, air spaces and cork, and heating and cooling are accomplished by means of heat conduction through these walls from the outer air spaces. This arrangement lends itself to extremely accurate control of temperature and humidity within the inner enclosure, the variations under normal operating conditions being too small for measurement. This may be called precision equipment. It is best adapted for use in tests requiring constant humidity and temperature for comparatively long periods such as corrosion tests, or for tests requiring extremely accurate and constant atmospheric conditions.



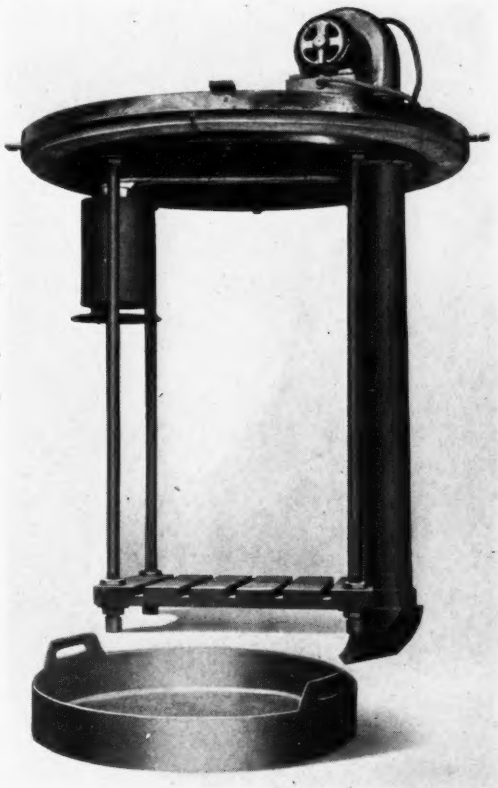
Small air-tight chamber for accurate humidity control

The type of portable equipment comprising the third group was developed in response to the demand for a low cost equipment suitable for use in commercial inspection-testing of raw materials and manufactured articles such as wire and small apparatus, and to provide additional equipment for laboratory testing. Twelve or more of these units are now available, each having a capacity of approximately eight cubic feet. This equipment consists of a large earthenware crock surounded by a wooden case, the space between the crock and case being filled with granular cork for heat insulation. A thick wood top is provided on which is mounted a small blower for circulating the air in the crock, a rack for holding samples, and a heater lamp controlled by a thermostat located in the blower intake duct. Humidity is controlled by a saturated solution of a suitable inorganic salt. The humidity within the enclosure is measured by means of wet and dry bulb ther-

mometers inserted in the blower intake duct through a cork.

The equipment is capable of producing humidity conditions ranging from thirty per cent to ninety per cent and temperatures from approximately room temperature to 100 degrees F. No provision is made for obtaining conditions below room temperature, but if such a condition is required, the whole apparatus may be placed in a cooled enclosure. Under normal operating conditions, the humidity is maintained within plus or minus two per cent and the temperature within plus or minus one degree F.

The use made of the sulphuric acid and saturated salt solutions rests on some very interesting physical facts. If pure water is placed in an air-tight chamber, the humidity will increase until saturation or 100% relative humidity is reached. According to the accepted theory molecules of water moving about in the liquid at high velocity escape from the surface and fly about in the space above it. Some molecules return but the number returning is less than the number escaping and consequently the amount of water vapor in the space increases steadily until finally the number returning is equal to the number escaping and no further increase in water vapor is possible. The space is then said to be saturated and the relative humidity is one hundred per cent. The vapor exerts a pressure inside the chamber and that exerted at one hundred per cent humidity is called the vapor pressure of the water at that particular temperature and pressure. The relative humidity at any time during this evaporation process may be defined as the ratio of the number of molecules per unit volume to the number per unit volume at saturation, or since for a given temperature the vapor pressure is proportional to the number of molecules the relative humidity may be defined as the ratio of the vapor pressure in the space above to the vapor pressure of the liquid.



Portable heating and circulating equipment, used with a crock which forms the testing chamber

If a soluble material which has practically no vapor pressure of its own is added to the water, the vapor pressure of the solution becomes less than that of pure water. Therefore, if an aqueous solution such as a sulphuric acid or soluble salt solution is placed in the chamber, the humidity at equilibrium will be less than one hundred per cent; choice of the proper concentration will give whatever predetermined humidity condition may be desired.

For humidity control systems which are practically air-tight, sulphuric acid solutions possess certain advantages over saturated salt solutions. Humidities ranging from five per cent to one hundred per cent may readily be obtained by simply varying the concentration of the solution. The effect of small changes in temperature on the resulting humidity is negligible, the change in humidity being in general less than one-tenth per cent per degree centigrade. Sulphuric acid itself has practically no vapor pressure, the most delicate tests having failed to indicate any trace of acid fumes in the atmosphere of the test chamber.

For humidity equipments which are not completely air-tight, such as the portable units described above, sulphuric acid solutions or other unsaturated solutions are not satisfactory since the concentration gradually changes by evaporation or by the addition of water absorbed from the atmosphere. This difficulty has been overcome satisfactorily, however, by the use of saturated salt solutions. As an example, a saturated solution of sodium chloride (common salt) has a definite vapor pressure at a given temperature which will give a humidity of seventy-five per cent. If an excess of the salt is present in the solution the addition or evaporation of water has no effect upon the vapor pressure since the solution is at all times saturated. Thus it is possible to maintain a practically constant humidity in a non-air-tight system provided, of course, that reasonable precautions to restrict air leakage are observed.

Data are available in the literature on the vapor pressures of saturated solutions of soluble materials which may be used to control humidity over a wide range. Also in many cases, two or more salts may be used in combination to increase the range of humidity obtainable by this method. In the laboratories, this method has been used mainly for maintaining humidities ranging from sixty-five per cent to ninety-five per cent, but it is known that humidities at least as low as thirty per cent are similarly obtainable.

In the use of this method some precautions should be observed. Temperature has in general much greater effect upon the vapor pressure than is the case with sulphuric acid solutions. In some cases the vapor pressure-temperature curve is apparently irregular. The stability characteristic of each salt should also be known in order to insure freedom from gaseous impurities in the test chamber. In short, each salt must be given careful consideration as to its characteristics before being used. Such precautions having been observed, however, saturated salt solutions have the advantages of being inexpensive, easy and safe to handle and requiring no maintenance even though the conditioning period may extend over many months.

Commercial Generator for Central Office Power Plants

By M. A. FROBERG
Systems Development Department

WITH the development of the electrolytic condenser, it has been found possible to substitute for central office charging purposes a commercial generator for the Type M generator now standard.

The Type M generator was originally designed to furnish "quiet" current to storage batteries and telephone circuits and it has fulfilled its functions in a very satisfactory manner. Recent tests made with generators of commercial design equipped with suitable filters indicated that direct current could be furnished to central offices at a smaller cost than with the type M generator. The development in the Laboratories of the electrolytic condenser, an essential element in these filters, was described by H. O. Siegmund in the RECORD for April, 1927.

While a storage battery can be charged by any direct-current generator of suitable voltage and output, telephone generators have been required to do much more than charge the central office battery. Much of their output goes into talking circuits to be modulated by telephone transmitters. It goes without saying that such currents must not contain alternating components within the audible

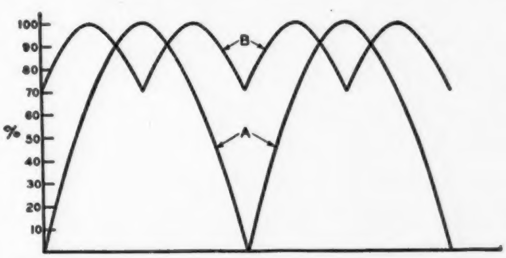


Fig. 1. Voltage waves of a simple direct-current generator: (A) of a single coil; (B) of two coils

range. Hence the Bell System has always insisted that a charging generator must have as "quiet" an output as possible.

Why a direct-current generator of the usual commercial type will have an output too noisy to use in a telephone circuit is evident from its de-

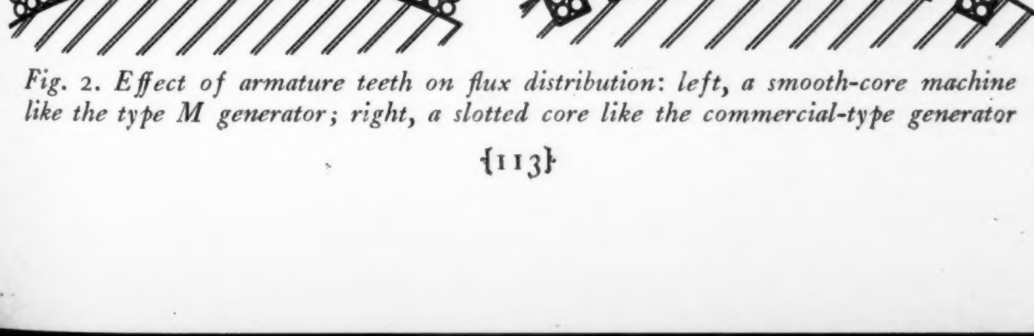


Fig. 2. Effect of armature teeth on flux distribution: left, a smooth-core machine like the type M generator; right, a slotted core like the commercial-type generator

sign. A single coil rotating in a magnetic field produces a voltage which rises from zero when the conductors are between poles to a maximum when they are under the poles and cutting the flux at its densest point. This cycle is repeated for each pole, and so a plot of the voltage for such

Fig. 3. Voltage wave of a typical commercial-type generator

a single-coil generator would resemble A of Figure 1. Such a generator, with its voltage swinging from zero to maximum at a frequency equal to the number of poles times the revolutions per minute, would be impossibly noisy. If two coils were used in place of one, the potential curve would resemble B of Figure 1. This is a big improvement as the magnitude of the ripple in the voltage wave is cut considerably. As the number of coils is further increased the ripples are reduced still more in size.

These basic variations in the voltage wave are not the only ones, however. The armature coils are laid in slots and the flux, concentrating naturally in the teeth due to their greater permeability, has an uneven distribution. As a result, corresponding high-frequency ripples are generated due to the flux dropping back from tooth to tooth as the armature rotates. Another source of irregularities in the voltage wave is variation in the air gap which causes differences of flux densities. A typical result of these factors and other minor ones is shown in the oscillogram pictured as Figure 3. The direct-current voltage here is about sixty but superimposed on it are the ripples, shown with a magnitude of over two volts, which make the current far too noisy for use in talking circuits of the usual types.

Because of these facts it was necessary to design a special machine with a more nearly smooth and thus quiet voltage wave. As a basis a large number of coils were used with a correspondingly large number of bars in the commutator. A smooth-core armature was utilized as shown in Fig-

Fig. 4. A type M generator, driven by an induction motor

ure 4 and by the elimination of the teeth a more even distribution of flux was obtained. The type M generator, as it was called, differed also in other minor ways but as a result gave splendid service. Scarcely any variations in the voltage line can be detected on an oscillogram.

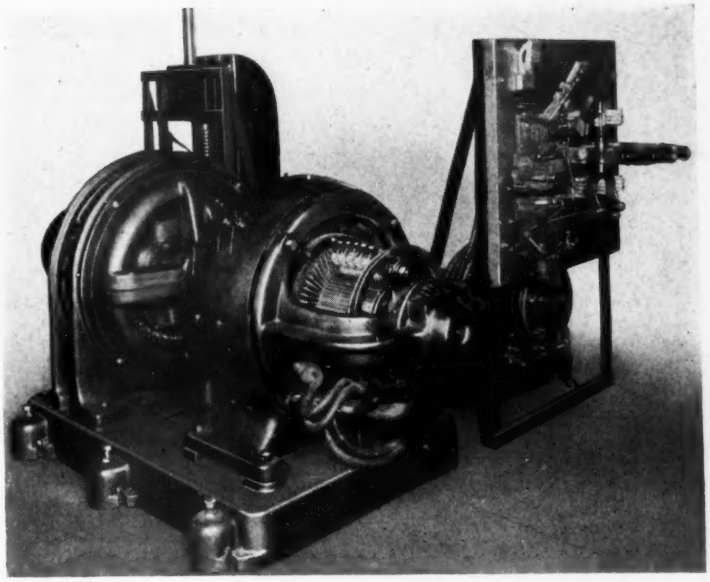


Fig. 5. A commercial-type generator, driven by a synchronous motor

It is obvious that the type M machine should cost more to manufacture than a commercial type generator because of the special design and of the small number made each year.

It is expected that in addition to the savings in first cost which will be made by employing commercial generators, there will also be a saving in maintenance; the brass gauze brushes of the Type M generator have probably required more frequent attention than will the carbon brushes of the commercial-type machine.

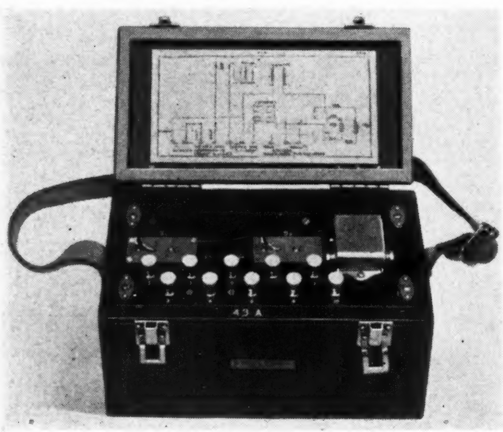
With the availability of suitable filters to suppress noise-making currents, it became possible at once to use the commercial machine and save both in original cost and in upkeep. Before the commercial generators were put into general use, however, extensive field tests were conducted by engineers of the American Telephone and Telegraph Company and the Laboratories in the panel office at Stillwell, Long Island City, in the combined step-by-step and toll office at Reading, and in a manual office at Wellesley, Massachusetts. These installations proved the value of the equipment economically and from the standpoint of circuit noise as well.

Coincident with the change of generators, the synchronous motor has been made available as the driving element. This has brought about an improvement in power-factor, not only of the unit itself, but of the entire central office installation, since the synchronous motor can be operated at a leading power factor to offset the lagging current of induction motors used for other conversion units and for other purposes. In one case it would have been necessary to install an expensive condenser for power-factor correction, had not the synchronous motor been available.

Cable Splicers' Test Set

By H. C. RUBLY
Apparatus Development Department

MORE than is at first evident is involved in the splicer's job of joining together adjacent lengths of telephone cable. In many cases each wire must be identified by the splicer and by his helper at the other end of the cable section, so that connections can be made according to plan. Defective wires must be identified and segregated. For part of the work splicer and helper must communicate with each other, and in addition it is often necessary for them to be within call of the central office.



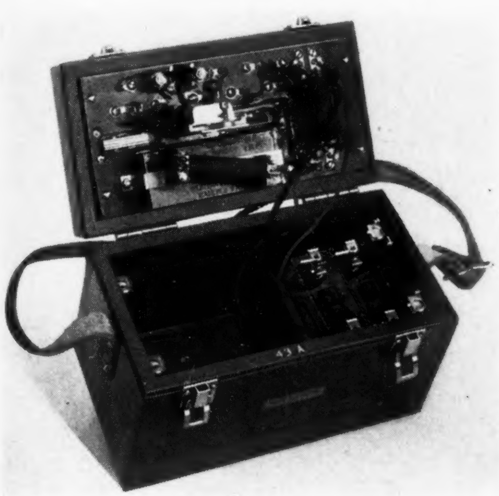
The test set ready for use

Portable apparatus for testing has been provided almost as long as cables have been used. Talking facilities between splicer and helper and a buzzer by which they could be called when wanted, at first provided separately, were later combined with the test sets. Thus modified, the sets have been reasonably satisfactory, depending upon the ingenuity of the user, and have remained practically unchanged in circuit essentials for over twenty years. In arrangement and mounting, however, the greatest diversity has been shown. From the earliest stage when the circuit members were mounted on boards or in similar informal fashion, the assemblies passed through many stages, culminating generally in portable apparatus designed by each of the Associated Companies for its own use. It is with these sets and with Western Electric test set No. 16A, now superseded, that the necessary tests have been made during installation and maintenance of local cables.

A standard test set, No. 43-A, has been designed in collaboration with T. C. Henneberger and A. L. Richey of the Department of Development and Research of the American Telephone and Telegraph Company, and is manufactured by Western Electric. Embodying all the features needed for installation and maintenance of local cables, it gives greater compactness and convenience than the older sets which it supplants. It weighs only eight pounds, and is less than a foot long and about six inches square; it can therefore be taken into a manhole or to the top of a pole with a minimum of inconvenience. Yet it fits the splicer to meet all the routine requirements of his work, and in addition equips him to locate sev-

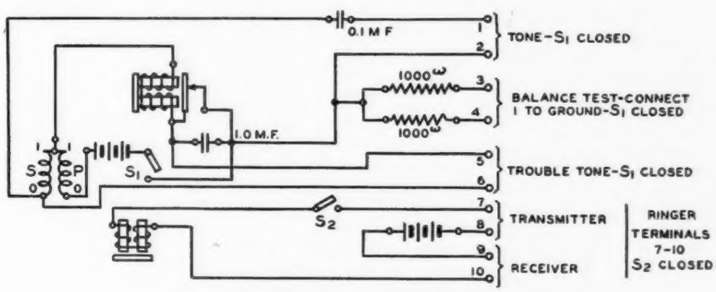
eral types of faults in cable already installed.

For identifying wires before splicing, one of the first requirements, tone is provided between terminals 1 and 2 by the interrupter and induction coil connected to the battery. One of the terminals is connected to ground by the splicer, and the other to the wire chosen. Then the helper at the other end of the cable section connects one side of his receiver to ground, and the other side successively to various wires of a hundred-pair group,* until he is notified by the tone which has come through from the test set that he has picked the wire chosen by the splicer.



Circuit members assembled on lower side of the panel

For comparing capacitances of wires or of pairs, two non-inductive resistances of a thousand ohms each are provided, connected to terminals 3 and 4. A splicer connects to one of the terminals a wire or pair of wires which he knows is good; then



Circuit diagram of the test set

he connects the wire or pair to be tested to the other terminal, and attaches his receiver to the two terminals, thereby forming a Wheatstone bridge. Alternating current from the induction coil passes to ground from terminal 1, and in case of unbalance to ground in capacitance of the wires or pairs being tested, it flows through the receiver between terminals 3 and 4, resulting in a tone there.

For conversation between splicer and helper, terminals 7 and 8, and 9 and 10 provide for connection of transmitter and receiver; the battery between terminals 8 and 9 energizes the talking circuit. A line from the central office is connected to terminals 7 and 10 when a call is expected, and the switch S2 is closed; at such times the receiver and transmitter should not be connected to terminals 7 and 10, since the shunt which they provide makes it possible that the buzzer may not be operated when a signal is received.

The battery between terminals 8 and 9 provides, in addition to talking current, a source of current for the "receiver-battery" test, by which defects of almost any sort in new cables

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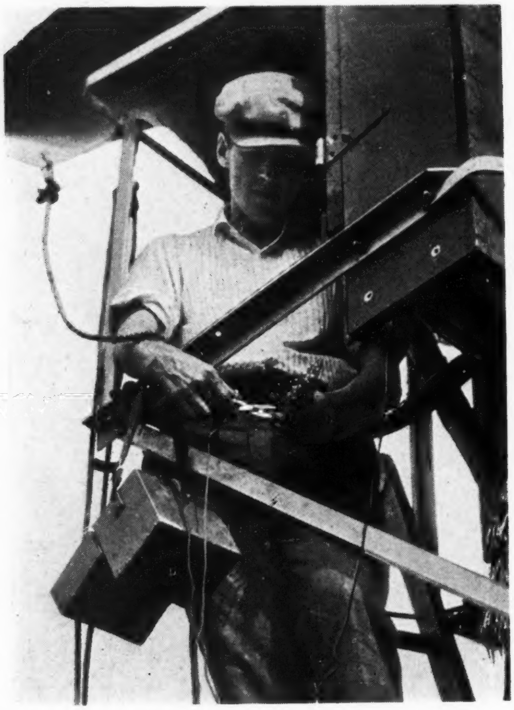
**Each group of not more than one hundred pairs is identified by the color of insulation of each pair.*

are detected. For broken wires, grounded wires, crossed or short-circuited pairs, the battery is connected through a receiver in succession to the



The "receiver-battery" test; contact is made with each wire in turn by the scissors

various wires. In testing for a grounded wire, the other terminal of the battery is connected to the cable sheath; when the defective wire is reached in testing a flow of current passes through the receiver, and is registered by a click. Wires broken, crossed and short-circuited are found in somewhat similar fashion.

It is at times necessary to locate faults that develop in cables during service. A test set for this special use, 20-C, is ordinarily employed, but since on account of other requirements the 43-A set contains the necessary parts, it can be used for fault locating on certain types of cables. The "trouble tone" or "exploring coil" tests that are made consist in sending alternating current through the defective wire, and getting it back through the cable sheath or another wire, depending upon whether the fault is a grounded or a crossed wire. The changing magnetic field surrounding the cable is picked up by an "exploring coil," really the secondary of an air-core transformer of which the circuit under test is the primary. The exploring coil is in a varying magnetic field as long as it is between the test set and the circuit fault, but when it passes beyond that point a current is no longer induced in its windings, if the circuit is short and non-loaded. Under such circumstances the two manholes or two poles between which the fault exists can readily be found; when desired the defect in an aerial cable can be found within a few inches by use of a ladder or a suspended seat by which the exploring coil can be taken to any point.

The 43-A test set is not intended for use with toll cable, where testing in installation and maintenance is much more exacting. For local cables, however, its accuracy, completeness and convenience make it an excellent tool for all-around work.

Strength-Tests of Telephone Materials

By J. R. TOWNSEND
Apparatus Development Department

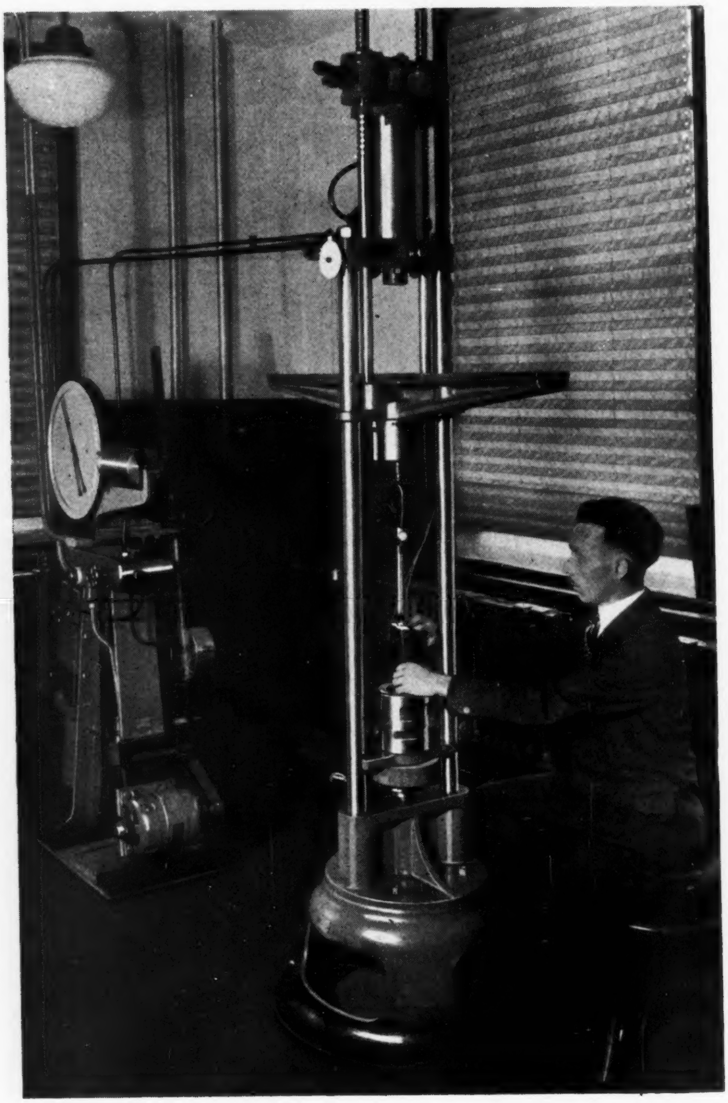
RECENT developments in the mechanical arts have been of necessity away from the ponderous, slow-moving machines of an earlier day toward the concentration of large power in small bulk, with accompanying high unit stresses. Compare the giant alternators of twenty years ago, with their huge triple-expansion engines, to modern turbine-generators; visualize the original gasoline engine alongside an airplane motor — one hundred times the power for the same weight. To gain these advantages, newer and stronger materials were developed: we see cast iron replaced, in turn, by wrought iron, steel, and finally alloy steel—each step an enormous advance in strength and durability.

Under the stress of the World War, still further economies had to be effected, and engineers throughout the world reluctantly reduced factors of safety. Then surprising things happened. Machine parts broke in service although they were not stressed to more than half their ultimate strength. Several series of investigations were started: one by the National Research Council, to which the Western Electric Company, among others, contributed. This work was carried on at the University of Illinois; other investigations were made at the United States Naval Experiment Station and by Army engineers at McCook Field.

A machine built in the Laboratories for fatigue tests of sheet spring material, and W. S. Hayford, its designer

As a result of these tests our ideas of strength-of-materials have been completely revolutionized. It is now realized that the classical theory treated metals as homogeneous and

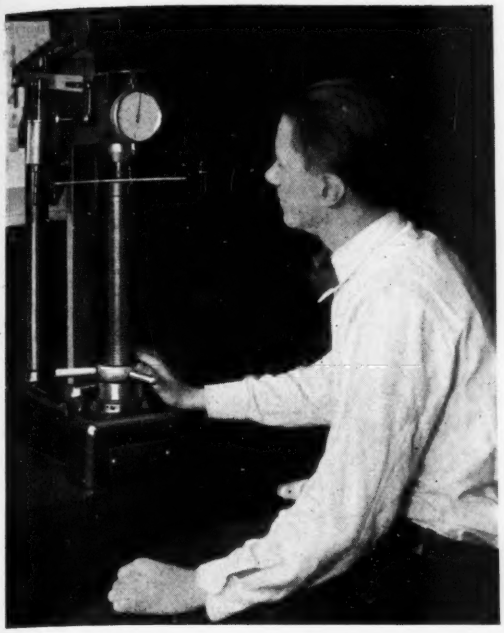
as having the same properties in every direction. These assumptions are now known to be untrue; for example, modern metallurgical studies show that metals that have undergone certain treatment may be composed of long, narrow crystals which impart to the specimen a rather fibrous structure. Further, no account had been taken of the effect of *repeated* stresses, in spite of the publication in 1860 by Woehler of a long series of tests. Woehler showed that when stressed again and again, iron and steel will withstand much less than their ultimate (static) strength; that the specimens will hold their strength practically up to final failure, and that they will break with no warning whatever.



The laboratory's most versatile machine: it will determine resistance up to 20,000 pounds to tension, compression and bending stresses. L. J. Burns is pictured as he prepares for a test of tensile strength

As a result of the tests of the last few years, it has been demonstrated that for steel the safe limit for repeated stress is but forty to fifty per cent of the ultimate strength, and for annealed brass it is only thirty per cent. Tests at the Forest Products Laboratory have found definite limits for the wood used in airplanes, at about thirty per cent. A number of investigations have shown that concrete, too, has its limitations: fifty to fifty-five per cent of its ultimate compression strength.

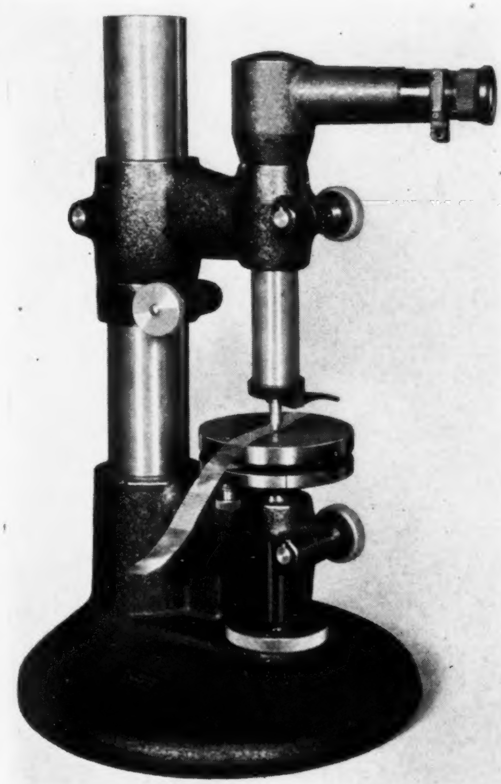
Certain telephonic materials are subjected to repeated stress: cable sheath, for example, and contact springs. In the General Apparatus Development Laboratory we are actively engaged in fatigue studies of cable-sheath alloys, and of spring materials. We have



A Rockwell hardness-tester in use by E. F. Berry

endurance limit should be used, with the static tensile test as a quick inspection test only.

Another property of materials which has received much attention is that of hardness. This may be defined as the resistance of a material to deformation—in particular, to the deformation caused by pressing a small penetrator into the body of the material. This property is tested directly by the Brinell and Rockwell methods and indirectly by the scleroscope. All of these methods are used in our laboratory. The Brinell test is to force a steel ball into the specimen and measure the diameter of the resulting indentation. This value, and the pressure applied, give a



Differences in thickness of one hundred-thousandth of an inch are detected by this instrument

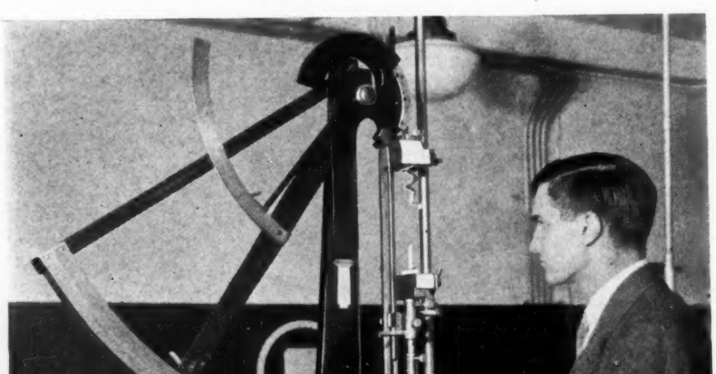
learned a great deal about the effects of alloying substances, of heat treatment, of working, of manufacturing defects, and of abuse during adjustment of spring parts.

Results of all these investigations have completely revolutionized our ideas of mechanical testing of material. Until recent years, much testing concerned itself mainly with dogmatic procedures where the breaking, twisting and bending strength were determined. Results of static tests on small samples were applied to the design of structures of great size, often subject to dynamic stresses. In the light of our present knowledge, it seems remarkable that these earlier structures were so successful and that disaster was so rare. The answer lies in the generous factors of safety allowed. Nowadays we believe that the elastic limit cannot be taken as a safe basis for design. Rather, the

numerical measure of the hardness. The Rockwell test is similar, but on account of its smaller penetrating-point and lighter loads it is better adapted to thin sheet metal and to soft metals such as aluminum and lead. The scleroscope measures the rebound of a weight when dropped from a fixed height on the test specimen. This test is not well suited to sheet metals because it is too sensitive to casual variations in the testing instrument itself.

All of these hardness tests are comparative rather than absolute; in some cases their results have been found to correspond closely with the performance of materials in actual service; in other cases they are entirely valueless. Considerable work is being done to associate hardness with other physical properties. Hardness is often considered as an indication of ultimate tensile strength. On the other hand, work done in these Laboratories on lead alloys has shown that annealing will effect enormous changes in hardness and practically none in tensile strength.

Since Hawthorne makes extensive use of drawing operations on sheet metal, it is important to know the suitability of materials for this work. The Erichsen test is to force the sheet into the form of a cup whose depth before the material cracks is a measure of ductility. This is a "static" test; its results do not reveal the performance of a material on a punch or forming press at production speeds. A "dynamic" test has therefore been worked out in which the cupping is carried forward at ninety strokes a minute, to simulate factory conditions.

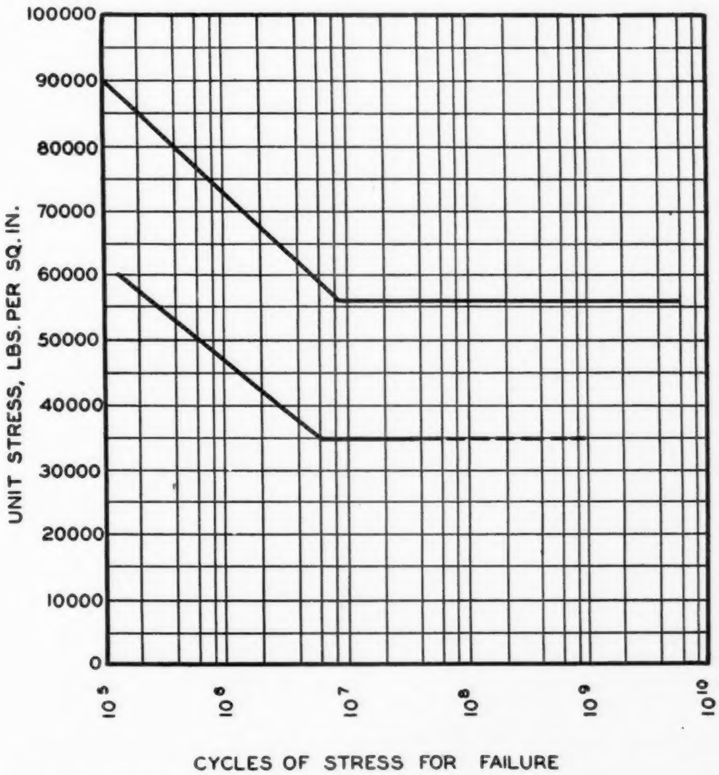


Tensile testing of thin metals: a sample of duralumin diaphragm-stock has just been broken by I. V. Williams

Impact tests are also made in this laboratory by allowing a pendulum to swing against and break a sample of the material. The pendulum will fail to rise to its free-swinging height by an amount which measures the work done in breaking the sample. This value is useful in comparing molded and cast materials, particularly die castings, as to brittleness.

To keep pace with the exacting requirements as to strength, lightness and cost which are being placed upon materials, there is hardly any form of

testing which is not undergoing revision today. In one direction, tests are being simplified and standardized so that they can be used in the inspection of raw materials; in another direction new tests are being designed to reproduce under controlled conditions the stresses which materials will meet in actual service. Both paths converge at the goal of better and more dependable materials for the telephone plant with a saving to telephone users.



Graph of Woehler effect - reduction in breaking stresses as tests are repeated

News of the Month

To JOHN J. CARTY, Vice-President of the American Telephone and Telegraph Company and Chairman of the Board of Bell Telephone Laboratories, has been awarded the John Fritz Medal "for pioneer achievement in telephone engineering and in the development of scientific research in the telephone art". This gold medal is awarded not oftener than once a year for notable contributions to scientific or industrial progress. Among the distinguished engineers who have previously been awarded the medal are Lord Kelvin, George Westinghouse, Alexander Graham Bell, Thomas Alva Edison, General George W. Goethals and Orville Wright.

MR. JEWETT attended the Presidents' Conference held at Yama Farms, October 11 to 17.

MR. CRAFT entertained at luncheon Admiral Bullard and two other members of the Federal Radio Commission, Messrs. Pickard and Caldwell, on October 28. The guests made an inspection visit of the Laboratories preceding the luncheon.

* * *

MEMBERS OF Edward J. Hall Chapter of the Telephone Pioneers of America, and relatives, about four hundred and fifty in number, attended a television demonstration in the auditorium the evening of November 2. John Mills introduced H. E. Ives, and spoke briefly of the development work leading up to the public demonstration. Then Dr. Ives described the requirements and methods of television, illustrating his talk with lantern slides. The meeting ended with a demonstration of the apparatus.

R. V. L. HARTLEY spoke at the Colloquium on October 24, on "Frequency Relations in Electrical Communication". At the next meeting, November 7, K. K. Darrow spoke on "Resonance Radiation".

RESEARCH DEPARTMENT

HARVEY FLETCHER was the principal speaker at a luncheon of the New York League for the Hard of Hearing, held October 21 at the Hotel Commodore. Telling of the astonishing number of school children shown by investigation to be partly deaf and the degree to which their progress in school is retarded, he called attention to the need for thorough measurement of hearing of all the pupils and medical care for those shown to need it.

A. C. KELLER, E. Dickten, C. B. Northrop and I. S. Rafuse conducted special tests on high-speed circuit breakers at Bryn Mawr, Pennsylvania, for a period of about two weeks. The tests were made jointly for the American Telephone and Telegraph Company and the Pennsylvania Railroad.

H. A. FREDERICK, F. Gray, C. R. Moore, H. H. Lowry, A. W. Hayes and J. T. L. Brown were at Hawthorne, arranging certain features of handset manufacture.

A. G. RUSSELL visited the laboratory of the Chromium Corporation at Waterbury, Connecticut, on No-

vember 3 to inspect equipment and methods for chromium plating.

O. J. FINCH, W. G. Knox and H. Boving made a general inspection of the experimental and testing laboratories for Duco lacquers at the Du Pont works at Parlin, New Jersey, on November 4.

R. R. WILLIAMS and H. H. Lowry visited the electrical engineering laboratories of Johns Hopkins University, Baltimore, on October 25, and were especially interested in the work on insulating materials.

H. E. IVES delivered a lecture on television to a meeting of the Western Society of Engineers, held in Chicago, October 17. At a meeting of the Optical Society of America held at Schenectady on October 20 he presented a paper written by himself and A. L. Johnsrud, jointly, entitled "The Thickness of Spontaneously Deposited Photo-electrically Active Rubidium Films, Measured Optically."

THE JOHN SCOTT MEDAL recently awarded to H. E. Ives was formally presented to him at a meeting of the Franklin Institute held at the Institute's rooms in Philadelphia on November 16.

APPARATUS DEVELOPMENT DEPARTMENT

E. B. WHEELER spent the week of October 24 at Hawthorne in connection with development of enameled wire and of switchboard lamps. On the return trip he inspected the manufacture of Blue Bell dry cells at the factory of the National Carbon Company at Fremont, Ohio, and visited the new toll office at Cleveland.

E. L. NELSON spoke at the monthly luncheon of the Western Electric Company on December 2, on "Our New High Power Broadcasting Equipment".

F. R. MCMURRY has been at the factory of the Morkrum-Kleinschmidt Company in Chicago for several weeks, inspecting and testing models of the 15-type telegraph printer.

THE WHIPPANY LABORATORY was visited on November 14 by representatives of the metropolitan newspapers and radio magazines. Equipment, particularly the new fifty-kilowatt broadcasting transmitter, was explained and demonstrated by E. L. Nelson, A. W. Kishpaugh, F. M. Ryan and their associates.

G. A. ANDEREGG spoke on "Submarine Cable Engineering" at the meeting of the American Electrochemical Society held November 18.

W. V. WOLFE was at Chicago as a member of the Sub-Committee on Interference of the National Electric Light Association. The purposes of the committee are to inform power company officials on the problems involved in power line carrier telephone work and to formulate plans for avoiding interference between adjacent carrier systems.

R. D. GIBSON, J. D. Sarros, K. O. Thorp and C. N. Nebel are on the Pacific coast, installing a power line carrier telephone system of new type on transmission lines of the Pacific Gas and Electric Company. This system will provide communication between Claremont, a district in Oakland, and Pitt River, two hundred miles away.

SYSTEMS DEVELOPMENT DEPARTMENT

C. BORGMANN, H. G. W. Brown, F. S. Kinkead and P. L. Wright visited the new toll office at Cleve-

land and the new panel-type dial office there.

W. J. LACERTE inspected new centralized testing equipment in step-by-step offices at Reading, Pennsylvania.

F. B. ANDERSON visited Philadelphia and Reading in connection with a study of high resistance faults in toll cables. For the same study R. A. Jascoviak went to the repeater stations at Harrisburg, Pittsburg, Bedford and Ligonier, and at Shippensburg, Maryland.

E. K. EBERHART visited the step-by-step offices at Reading and Allentown, Pennsylvania, for studies of lighting equipment used in central offices.

F. F. SIEBERT and C. W. Van Duyne visited the Westinghouse Electric and Manufacturing Company at East Pittsburgh.

S. B. WILLIAMS addressed the student branch of the American Institute of Electrical Engineers at the City College of New York on November 17. He spoke on telephone switching, and showed the film, "Through the Switchboard".

C. H. ACHENBACH went to Hawthorne in connection with improvements in panel-type dial offices.

Outside Plant Development Department

R. L. JONES and C. S. Gordon, with engineers of the American Telephone and Telegraph Company and of the New Jersey Bell Telephone Company, conducted tests on a wire splicing device at Linden, New Jersey, on November 3.

E. M. HONAN and R. C. Dehmel were at the plant of the Habirshaw Cable and Wire Corporation in Bridgeport, Connecticut, on November 11, discussing problems involved in the manufacture of parallel drop wire.

J. M. HARDESTY and E. St. John conducted trials of transposition brackets at Mount Kisco, New York, on October 28.

L. W. KELSAY visited South Norwalk, Connecticut, and various places in Westchester County, New York, during the latter part of October, making investigations in connection with cable terminal installations.

Inspection Engineering Department

W. A. SHEWHART visited the Forests Products Laboratory at Madison, Wisconsin, on October 27 and 28.

P. S. OLMSTEAD was in Hawthorne during the first week of November in connection with inspection and manufacture of handsets.

E. G. D. PATERSON was in Pittsburgh from October 19 to 22, discussing quality control problems with Hubbard and Company, suppliers of outside plant hardware.

ON OCTOBER 18, W. C. Miller and O. A. Shann visited the Gray Telephone Pay Station Company in Hartford, Connecticut, to discuss manufacturing and inspection problems connected with the 50-G coin collector.

E. F. HELBING and E. C. Manderfeld visited Electrical Research Products, Incorporated, in Philadelphia on November 3, to inspect the stock of regulated motors used in tone reproducing systems.

ON NOVEMBER 7, L. E. Gaige was in Philadelphia to investigate questions of design, manufacture and packing of the woodwork of No. 550-C private branch exchange switchboards.

C. E. HOOKER and G. C. Porter

were in New Haven on October 21 and 22 to investigate trouble with the No. 2 Public Address System used in the New Haven Arena.

On November 7, A. Grendon visited Charles W. House & Sons in Unionville, Connecticut, to discuss the quality of felt used in bases for desk stands.

H. W. Newlund has been transferred to the St. Louis field territory to assist R. C. Kamphausen, Field Engineer in that territory.

Patent Department

H. A. Burgess, T. P. Neville and P. C. Smith visited Washington during the past month for the prosecution of patent applications.

General Staff Department

J. E. Moravec attended the recent conference of General Auditors of the Bell System at Absecon, New Jersey.

Helen M. Craig has been appointed Chairman of the Hospitality Committee of the New York Special Libraries Association for the coming year. Members of the Association are librarians in business, technical and museum libraries, and in special departments of public libraries.

M. L. Wilson spoke to about fifty students of the Science group of the West Side High School at Newark on November 4, and showed the film "The Magic of Communication."

Bell Laboratories Club

Basketball

Though the basketball team representing the Club in outside competition has for a number of years been capable of meeting the best semi-professional teams in the Metropolitan district, this year's team is even better. It has lost only one game so far, and has an excellent chance of winning the league championship. Those who have missed the past games still have a chance to see the team in action, at Stuyvesant High School. Wednesday evening, December 7, it will meet a team representing General Headquarters of the Western Electric Company; a week later it will play the Western Electric team from Hudson Street, the ancient enemies of the Laboratories on the basketball court.

Our group this year includes many veterans from previous seasons, notably O'Neil, Maurer, Gittenberger, Steinmetz, Trottere and Hanson. The new men are Christ, Hasior, Haglund and Hiscock. J. A. Waldron is coach and manager; from his knowledge of basketball comes a good part of the team's success.

The departmental league games began Thursday evening, November 10, at Labor Temple. Games are on Tuesday and Thursday evenings at 5:30; each team is to play fourteen times during the season. The league is managed by T. J. O'Neil of the main Laboratories team.

Winter Dance

The winter dance of Bell Laboratories Club will be held in the Grand Ballroom of Hotel Pennsylvania on Thursday evening, February 2. A prominent New York orchestra is to be engaged, and other corresponding

preparations made to insure an enjoyable evening for the guests. Tickets are one dollar and ten cents each, and box seats are one dollar and sixty-five cents each. Since the demand for box seats at these parties has always exceeded the number available, the Committee suggests that those planning box parties order accommodations at once from the club secretary.

Golf

The Golf Committee has arranged an indoor tournament for Monday evening, December 12, at the Vander-Built-In course, which is located at 41 East 42nd Street. Since our last indoor tournament eighteen additional holes have been installed; these will make our coming competition faster and smoother.

For the qualifying round, thirty-six holes of medal play, the entrants will be divided into two groups of approximately fifty each. The first fifty men to report to the starter will complete the qualifying round; it is suggested that while these are playing the others have dinner, and then prepare for their start about 6:30. From each group thirty-two players will be chosen, and these will be divided into eight flights for the elimination match play. A prize will be awarded in each group of the qualifying round to the player with low medal score, and to the winner in each of the eight flights of the finals. The entry fee is one dollar and fifty cents, to be paid before the night of the tournament.

Men's Bridge Club

The tournament of the men's bridge club, which started October 10, has brought to light many new stars. This year the leaders are F. V. Borland, E. M. Noll and C. A. Smith. Mr. Smith turned in a plus score of 2170 on October 17—a score for one evening's play which we think all bridge players will recognize as excellent.

Bowling

From present indications 1929 will see the Laboratories bowling league using all forty-two alleys at Dwyers. At the start of this season twenty-eight alleys were engaged, but now even these are insufficient for those who wish to bowl. For the past six seasons the league has been made up of three groups, each with eight teams. The additional group of four teams started this year has been so successful that it will be expanded to a full group of eight at the start of next season.

Many of the scores made this season have been exceptionally good. H. C. Dieffenbach, Group A, broke all league records on Friday evening, November 4, when he averaged 225 for three games. His scores were 249, 234 and 192. A. A. Carrier holds high score for a single game in Group B, 243.

Women's Basketball

The women's basketball squad is continuing vigorous practice under the guidance of C. Gittenberger, with about twenty members. Marie Boman has been busily engaged in arranging the work and in lining up games for the coming season. These will start on the fifth of January, when a game will be played with the Manhattan division of the New York Telephone Company. Later there will be a game with the International Telephone and Telegraph Company, and two each with the Seaboard National Bank and the Vacuum Oil Company; others are being arranged now.

Election of Club Officers

CANDIDATES for Bell Laboratories Club offices for the year 1928 have been selected by the nominating committee which consists of E. J. Johnson, D. D. Hagerty, J. G. Motley, G. H. Heydt, T. J. O'Neil, P. J. Higgins, A. L. Johnsrud, S. J. Stranahan and A. A. Reading.

Ballots will be mailed to all club members on Friday, December 16, and must be placed in the ballot boxes on Monday, December 19, between the hours of half-past 8 and 6 o'clock. No employee who is not a member of the club will receive a ballot. Membership application forms may be obtained from departmental representatives or from the club secretary. Applications received after December 14 will not entitle new members to vote in the current elections. The candidates are as follows:

For President

Maurice B. Long
Donald A. Quarles

For First Vice-President

William C. Calmar
George F. Fowler

For Second Vice-President

Elizabeth Van Duyne
Marie Boman

Departmental Representatives
Two Year Term

Apparatus Development

S. James Stranahan
Earl L. Fisher

Patent-Inspection Department

Robert J. Nossaman
Thomas C. Rice

Plant Department

George J. Seltzer
George Rupp

LONG FOR PRESIDENT

MAURICE B. LONG

For President

Entered the Laboratories, Research Department, 1919, after two years in the Bureau of Standards; he has been concerned, among other things, with picture transmission. Became Educational Director in 1925; has general charge of educational activities, and supervises selection of younger members of Laboratories. Represented the Research Department in 1924 on Board of Governors of the Club

LONG FOR PRESIDENT

QUARLES

QUARLES

QUARLES

Donald A. Quarles

For President

Served overseas during the War, before entering the Laboratories in 1919. Engaged in transmission engineering until 1924, when he was transferred to the Inspection Engineering Department. Now has charge of Apparatus Inspection. He is a member of the Bell Laboratories Club chess team, and has taken part in the golf tournaments.

QUARLES

William C.
CALMAR

"*The Choice with a Smile*"

A member of our Plant organization since 1897; now head of the Building Shop. His long experience has brought a thorough knowledge of the organization. A pleasant personality has earned a wide acquaintance throughout the Laboratories.

FOR FIRST VICE-PRESIDENT

For Second Vice-President

Elizabeth Van Duyne

Never known to miss a trick. Takes part in all the Club's social affairs. Has had a lot of experience in athletics, dramatics and general sociability. She has ideas, and knows how to put them into practice. Her present occupation keeps her in the Apparatus Development Department.

George F.
FOWLER

For First Vice-President

Since 1913 a member of the Laboratories. Has charge of Department and Visitors' service, Bureau of Publication. Active in the old Engineering Club. Has helped make a success of many social and educational functions for the Laboratories.

Marie Boman

The best part of the Bureau of Publication, and one of the most active and popular members of the Club. Manager of the women's basketball league; member of the basketball teams that have represented us in outside games; always at our dances; track star; never does a job half way.

For Second Vice-President

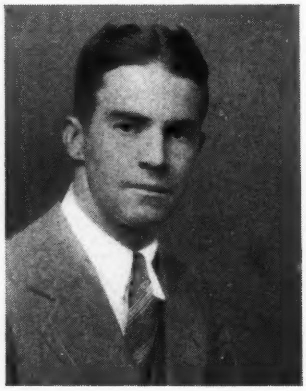
FOR DEPARTMENTAL REPRESENTATIVE

S. J.
STRANAHAN

Apparatus Development Department

E. L.
FISHER

Apparatus Development Department



R. J.
NOSSAMAN

Patent and Inspection Departments

T. C.
RICE

Patent and Inspection Departments

FOR DEPARTMENTAL REPRESENTATIVE

To Represent
the Plant Department

C. J.
SELTZER

To Represent
the Plant Department

George
RUPP

Patronize Our Advertisers

THE RECORD guarantees all candidates displayed in its columns to be 90-proof and of pre-war quality. Just off the ship. Here at last is an election in which a voter can scarcely make a mistake. From all directions are heard enthusiastic expressions of approval of the nominating committee's intelligence. And the committee's achievement is even better appreciated with the realization that it was only in response to an insistent public clamor that these ladies and gentlemen have permitted their names to be enrolled upon the ballot. They did not choose to run for office, but they have heeded the clarion call of duty, at a considerable personal sacrifice.

THE RECORD is pleased to announce that this year's presidential campaign will involve no noisy demonstrations. All electioneering will be carried on with a quiet dignity entirely becoming to the character of the candidates.

Transatlantic Telephony: A Factor in Metropolitan Life

To those of us at the Laboratories who have been associated with the development of transatlantic telephony—and who has not in one way or another—it is interesting to note the extent to which this service has entered the public's field-of-consciousness. This is frequently typified in jests and cartoons. That reproduced below is of interest for its humor but more particularly for its implication. Evidently this manufacturer of cigarettes has felt that, while he may be giving free advertising to another business, he has also projected his story against part of the common background of our every-day metropolitan life.

The transatlantic telephone service is now being advertised by the Long Lines Department through a series in the newspapers published on the larger ships plying between the United States and England. Two sets are used, stressing the interests, respectively, of those outward bound and of those homeward bound. A talk with one's family, communication with business associates, transatlantic sales calls, conversation after the return with one's hosts and foreign friends are among the uses suggested. Convenience and speed of the service are emphasized by the slogan "Days over—minutes back" used throughout.